PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Worm Extrusion Press for Working Ceramic Material

We, SOEST-FERRUM APPARATEBAU G.M.B.H, of Hansa-Allee 159, Düsseldorf-Oberkassel, Germany a German Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a worm extrusion press for working ceramic material.

With such extrusion presses, the refined or worked ceramic material is conveyed toward the ouside generally through a cone-shaped press head which, if desired, may be succeeded by a specially shaped mouth-piece. There are also extrusion presses with which the worked material is conveyed toward the outside directly through a mouth-piece.

Particularly when working fine ceramic materials such as porcelain, there has, for a long time, been noticed the drawback that the extruded strands; in spite of the most careful mixture and kneading after having left the press mouth-piece, show physical properties which are non-uniform from the outside toward the inside, which fact makes itself felt in a disadvantageous manner when further processing the extruded material.

Therefore, it has frequently become necessary to subject said material to an after-treatment, which treatment complicates the production process while not always leading to the desired result of a homogeneity of the material.

Heretofore, this drawback has not been overcome because its cause could not be ascertained. Theretofore, one was satisfied with extending the cone-shaped press heads in order thereby to influence the strand core. However, such an arrangement naturally caused an increased consumption of power and also brought about a non-uniform flow of the advancing material. Furthermore, the draw-backs above referred to could not be overcome in this manner.

In order to avoid the formation of inhomogeneous layers within the material, it has been suggested to provide the press core of worm extrusion presses with concentrically arranged cylindrical steps which decrease in diameter toward the mouth-piece, which steps are closely swept by pressing elements. Such stepped design of the worm press, however, does not eliminate the formation of inhomogeneous layers because the worm of the press remains, as before, the cause for the formation of such layers.

It is also known to design press mouth-pieces in the manner of a draw nozzle by having the press cylinder merge into the mouth-piece passage. Also with such structures, the formation of inhomogeneous layers cannot be avoided because the material is discharged in the immediate neighbourhood of the last course of the worm thread. The features observed in this instance are the same as those observed with cone-shaped press heads or mouth-pieces, because the large merging radius from the worm end to the mouth-piece is equivalent to the conical shape of the press mouth-piece.

It is, therefore, an object of this invention to provide a worm extrusion press which will overcome the above-mentioned drawbacks.

It is another object of this invention to provide a worm extrusion press for working ceramic material which will make it possible to produce strands of substantially uniform strength.

According to the invention, a worm extrusion press, for working ceramic material, comprises a worm which is adapted to engage the ceramic material to feed the latter through a tubular part having its interior diameter decreased step-wise to provide a discharge or feed passage having at least two interior peripheral shoulders facing the direction of feed of the ceramic material, each shoulder being of a convex rounded form in cross-section and terminating substantially abruptly at its junction with the adjacent larger-diameter passage portion, the said shoulders being arranged to cause the material fed past them by the worm to be kneaded and formed into a homogeneous or substantially homogeneous mass, and the bore of the discharge or feed passage being unoccupied by any interior device or combination of parts which would render the material inhomogeneous by the time it issues from the discharge end of the said passage.

Also, according to the invention, a worm extrusion press, for working ceramic material,

is adapted to make hollow tubular blanks and comprises a worm which is adapted to engage the ceramic material to feed the latter through a tubular part having its interior diameter decreased step-wise to provide a discharge or feed passage having at least two interior peripheral shoulders facing the direction of feed of the ceramic material, a core member being disposed inside said passage and having its diameter increased step-wise to provide the core with at least one peripheral shoulder facing the direction of feed of the ceramic material and disposed beyond (in the direction of movement of the material) any part inside the bore of the discharge or feed passage which might of itself cause inhomogeneity in the material, each of the said shoulders of the passage and core being of a convex rounded form in cross-section and terminating substantially arbuptly at its junction with the adjacent larger-diameter passage portion (or with the adjacent smaller diameter core portion), the said shoulders being arranged to cause the material fed past them by the worm to be kneaded and formed into a homogeneous or substantially homogeneous mass.

We are aware of Specification No. 6110 of 1909, which describes a machine for manufacturing pipes having at one end a socket produced by a stepped mould. The said specification does not disclose a discharge or feed passage having its interior diameter decreased to provide at least two peripheral shoulders each of a convex rounded form in cross-section and terminating substantially abruptly at its junction with an adjacent larger-diameter passage portion, nor does the said specification suggest that any inhomogeneities which might be present in the material would be removed.

The invention is illustrated, by way of example, in the accompanying drawings, in which:—

Figure 1 illustrates a longitudinal section through a press head with a mouth-piece, of an extrusion press for processing ceramic materials or masses;

Figure 2 represents a longitudinal section through a press head, with a mouth-piece, of an extrusion press for making tube-shaped blanks;

Figure 3 is an end view of the mouth-piece shown in Figure 2; and

Figure 4 is a longitudinal section through a press head, with a mouth-piece, of an extrusion press that is provided with a hollow drawing-device.

Referring now to the drawings in detail and Figure 1 thereof in particular, the structure shown therein comprises a feeding screw 1 mounted in an extrusion press (not shown in the drawing), which feeding screw presses the material to be processed in the direction of the arrow from the press-chamber 2 into the press head 3. In the particular embodiment shown in Figure 1, the press head 3 is succeeded by a mouth-piece 4 which may be exchangeable in a manner known *per se*.

In the embodiment shown in Figure 1, the interior diameter of the press-head 3 is decreased step-wise to provide a passage portion or chamber 11 of a diameter a and a passage portion or chamber 12 of a smaller diameter b, and the mouth-piece 4 is decreased in interior diameter relatively to the chamber 12 to provide a passage portion or chamber 13. In this way interior steps or shoulders 5, 6, 7, are formed, these steps or shoulders being of a convex rounded form in cross-section as shown at 8, 9, 10, and leading from the respective succeeding chambers 2, 11, 12, each shoulder terminating, as shown, substantially abruptly at its junction with the adjacent larger-diameter passage portion or chamber. This particular arrangement brings about that, in contrast to the heretofore smooth conically shaped inner surfaces of the press head and mouth-piece, the mass is suddenly dammed up, which, however, does not result in an accumulation of mass particles in said steps. Instead, the strand is compressed in its entirety, which fact imparts upon the strand the desired uniform strength. The rounded-off portions will bring about that the mass, without finding a backing, will be further compressed and compressed in itself.

The radii of the rounded-off shoulders should be at least of such magnitude as to equal half the difference of the diameters of successive spaces or chambers. Thus, for instance, the radius r of the rounded-off portion 10 should at least equal $\frac{b-c}{2}$. It should not exceed a maximum of $4/3\left(\frac{b-c}{2}\right)$ because otherwise, the curvature of the said rounded-off portion will be too weak to assure the desired effect.

In order to ease or calm the mass while it passes through the press head and the mouth-piece, a plurality of steps or shoulders are provided, as shown by way of example in Figure 1. Advantageously, the lengths L, L^1, L^{11} of the individual chambers or spaces 11, 12 and 13, respectively, as defined by the steps or shoulders, are the same. These lengths and thus, also, the number of steps depend on the size of the feeding flanks of the screw 1. In other words, the larger said feeding flanks, the more steps are desirable. The chambers or spaces 11, 12 are preferably cylindrical, as shown in the drawing.

With regard to the embodiment shown in Figures 2 and 3, the inner walls of the press head 3 and the mouth-piece 4 form steps or shoulders facing the direction of flow of the ceramic mass. The press head 3, shown in Figure 2, is provided with two steps or shoulders, namely, the first step or shoulder

reducing the respective chamber to the diameter *a*, while the second step or shoulder reduces the chamber confined thereby to the diameter *b*. The mouth-piece 4 shows a third reduction in diameter so as to reduce the inner diameter to the diameter *c*.

With the embodiment illustrated in Figure 4, there are a total of four different step-forming diameters, namely, *a*, *b*, *c* and *d*. The individual steps or shoulders 5, 6, 7 and 7¹ are rounded-off as shown at 8, 9, 9¹ and 10, and lead from the respective preceding spaces or chambers 2, 11, 12 and 12¹.

The convex shoulders 5 to 7 (Figure 2) and 5 to 7¹ (Figure 4) each terminate as shown, substantially abruptly with the adjacent larger-diameter passage portion or chamber.

The embodiments shown in Figures 2 to 4 enable hollow tubular blanks of the ceramic material to be formed, and for this purpose have a core body 14 (Figures 2 and 3) or 19 (Figure 4). Each core body, 14 or 19, has its diameter increased step-wise to provide peripheral shoulders 15, 16 (Figure 2) or 20, 21 (Figure 4), each shoulder being of a convex rounded form in cross-section and terminating, as shown, substantially abruptly at its junction with the adjacent smaller-diameter core portion. The steps or shoulders on the core body may be images to the steps or shoulders on the inner walls of the press head and mouth-piece. In other words, wherever there is a reduction in diameter on the inner wall there may be a similarly dimensioned increase in diameter on the core body. Thus, for instance, with the tube extrusion press of Figure 2, the diameters of the core body 14 increase from *e* to *f* and from *f* to *g* with rounded-off sections 15, 16, similar to the corresponding rounded-off wall sections 9, 10. The sizes of the radii 15, 16 are preferably selected similar to those of the radii 8, 9, 10, according to Figure 1. In a similar manner, the lengths L, L¹ and L¹¹ of the chambers 11, 12 and 13 are determined.

When the steps of a core body do not form images to the corresponding steps of the press head or mouth-piece inner wall, the invention makes possible advantageous embodiments, one of which is illustrated in Figure 4 in connection with an extrusion press having a hollow drawing device.

The hollow body 19 forming the core is connected through a chain 18 with the worm hub 17. This core body 19 has its two steps or shoulders 20, 21 within the mouth-piece 4 and beyond the chain 18, and the relatively small diameter *h* at the entrance to the mouth-piece increases to the diameter *i*, while the latter, when forming the second step or shoulder, increases to the diameter *k*. The rounded-off portions 22, 23 again correspond to the conditions outlined above in connection with Figure 1. Due to this arrangement and design of the core body 19, it is possible to draw hollow bodies free from inhomogeneous layers. Any inhomogeneities which might be caused by the connecting chain 18 are removed by the shouldered core body 19 disposed beyond the said chain.

It is, of course, understood that the present invention is by no means limited to the particular constructions shown in the drawings but also comprises any modifications within the scope of the appended claims.

What we claim is:—

1. A worm extrusion press, for working ceramic material, comprising a worm which is adapted to engage the ceramic material to feed the latter through a tubular part having its interior diameter decreased step-wise to provide a discharge or feed passage having at least two interior peripheral shoulders facing the direction of feed of the ceramic material, each shoulder being of a convex rounded form in cross-section and terminating substantially abruptly at its junction with the adjacent larger-diameter passage portion, the said shoulders being arranged to cause the material fed past them by the worm to be kneaded and formed into a homogeneous or substantially homogeneous mass, and the bore of the discharge or feed passage being unoccupied by any interior device or combination of parts which would render the material inhomogeneous by the time it issues from the discharge end of the said passage.

2. A worm extrusion press, for working ceramic material, the said press being adapted to make hollow tubular blanks, and comprising a worm which is adapted to engage the ceramic material to feed the latter through a tubular part having its interior diameter decreased step-wise to provide a discharge or feed passage having at least two interior peripheral shoulders facing the direction of feed of the ceramic material, a core member being disposed inside said passage and having its diameter increased step-wise to provide the core with at least one peripheral shoulder facing the direction of feed of the ceramic material and disposed beyond (in the direction of movement of the material) any part inside the bore of the discharge or feed passage which might of itself cause inhomogeneity in the material, each of the said shoulders of the passage and core being of a convex rounded form in cross-section and terminating substantially abruptly at its junction with the adjacent larger-diameter passage portion (or with the adjacent smaller-diameter core portion), the said sholders being arranged to cause the material fed past them by the worm to be kneaded and formed into a homogeneous or substantially homogeneous mass.

3. A worm extrusion press, as claimed in claim 1 or 2, wherein each convex rounded interior peripheral shoulder of the discharge or feed passage has a radius of convex curvature which is at least half the difference in dia-

meter between the two portions of the discharge or feed passage which adjoin at the said shoulder in stepped relationship to each other.

4. A worm extrusion press, as claimed in claim 1, 2 or 3, wherein different-diameter portions of the discharge or feed passage are of equal length.

5. A worm extrusion press, as claimed in any one of the preceding claims, wherein the portion, or each portion, of the discharge or feed passage between successive shoulders thereof is cylindrical.

6. A worm extrusion press, as claimed in any one of the preceding claims, wherein the tubular part comprises a hollow mouth-piece and an intermediate tubular connecting member connecting the mouth-piece to the chamber.

7. A worm extrusion press, as claimed in claim 6, wherein at least one of the interior peripheral shoulders of the discharge or feed passage is spaced intermediate the ends of the tubular connecting member, being formed on the inside wall of the said mmeber.

8. A worm extrusion press, as claimed in claim 2, wherein the shoulder, or each shoulder, on the core member corresponds to one of the interior shoulders of the discharge or feed passage and is the mirror-image to the said shoulder.

9. A worm extrusion press, as herein described with reference to the accompanying drawings.

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2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

Fig. 1

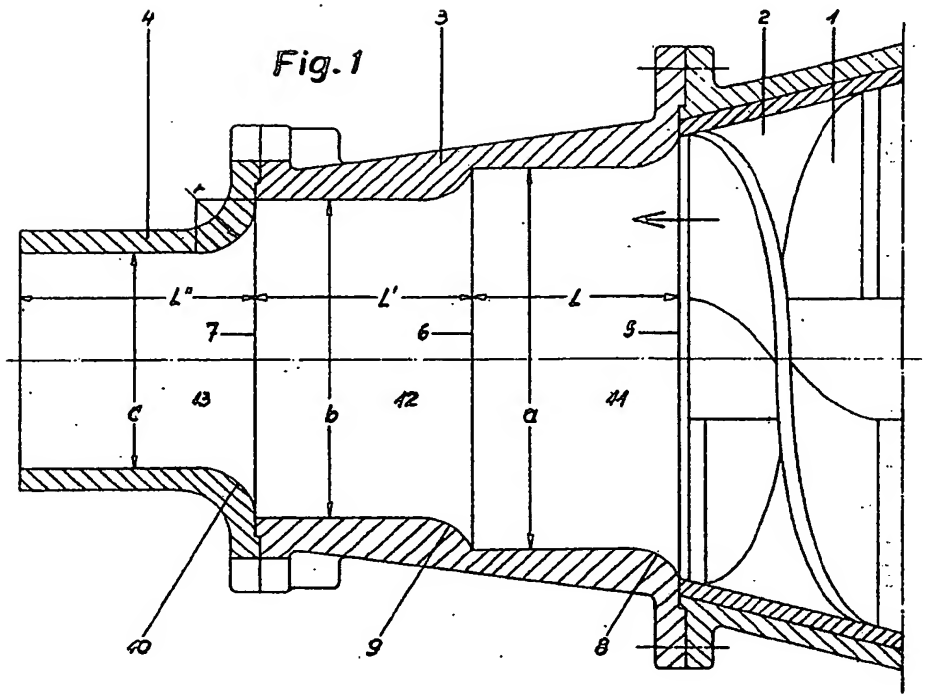
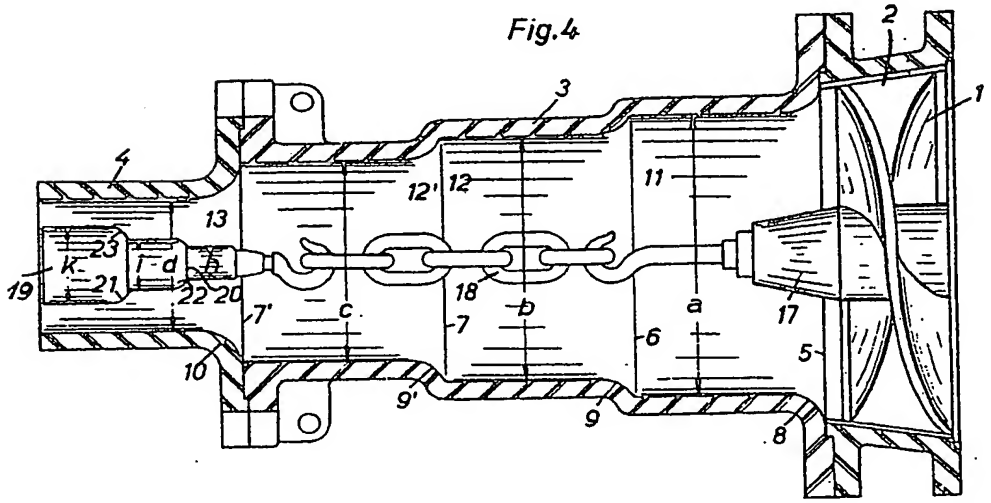


Fig. 4



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2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

Fig.2

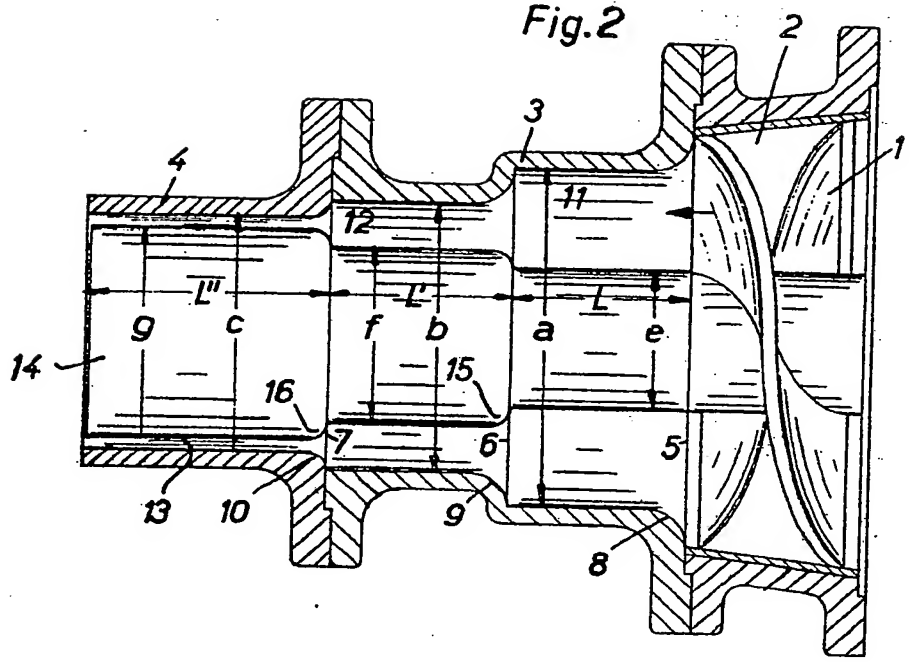

Fig.3